

Objectives

Define the term mitosis.

Explain why interphase is not a part of mitosis.

Summarize the four steps that occur during cell division.

Think back to the dancing men puzzle in the Sherlock Holmes story. Until Holmes collected more messages showing the dancing men, he did not have enough information to solve the puzzle of the code. Holmes wanted to understand how the code in the message worked so that he could write a message of his own.

Many scientists have worked on the puzzles involved in cell function. By studying a great number of cells under the microscope, they have been able to describe the key functions of cells. One very important function of cells is reproduction.

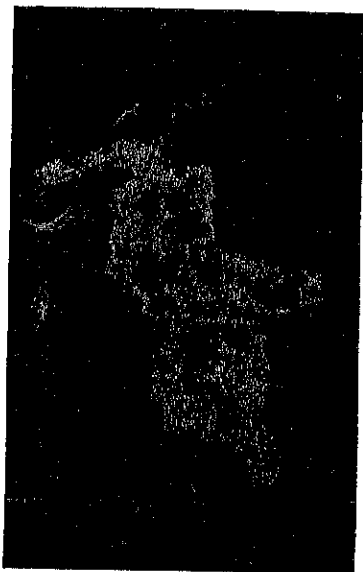
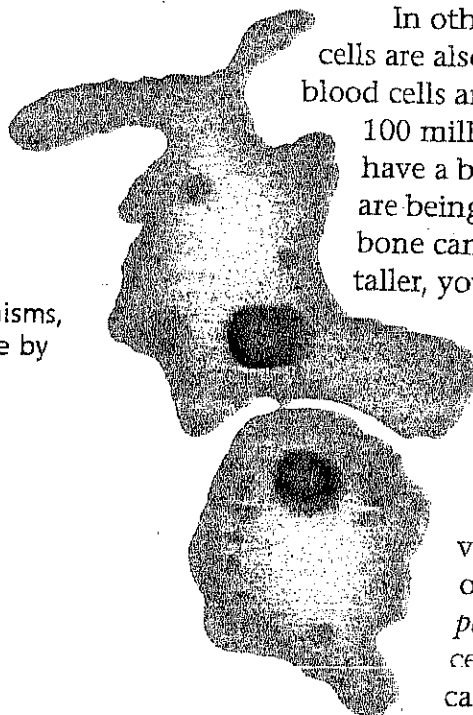


Figure 5-5. All living things reproduce. Single-celled organisms, such as this amoeba, reproduce by dividing into two new cells.

Methods of Cell Reproduction

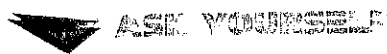
Look at your hand. Each square centimeter of skin is made of more than 150 000 cells. Most of these cells will be gone by tomorrow. During the next 24 hours, two complete generations of skin cells will live, reproduce, and disappear. What do you suppose will happen to the old skin cells on your hand during the next 24 hours?



In other parts of your body, other cells are also reproducing rapidly. Red blood cells are made at the rate of about 100 million cells a minute. If you have a broken bone, new bone cells are being made so that the broken bone can heal. Since you are getting taller, your bones are growing in length by adding new cells at the ends of the bones. There is much cellular activity taking place in your body.

Cells reproduce by dividing into two cells. The original cell is called the *parent* cell. The two new cells that are formed are called *daughter* cells.

division occurs when a single-celled organism splits into two organisms. Another type of cell division occurs in multicellular organisms when cells, such as skin cells, make exact duplicates of themselves. A third type of cell division occurs when sex cells, or reproductive cells, are produced.

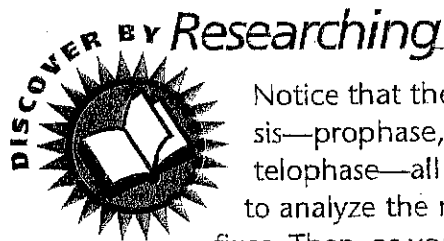


What is the purpose of cell division?

Mitosis

The type of cell division by which two daughter cells are formed is called *mitosis* (my TOH sihs). **Mitosis** produces daughter cells that are exactly the same as the parent cell. Mitosis is actually the process by which the cell nucleus duplicates. After the nuclear material is duplicated, the rest of the cell simply divides in two.

Mitosis is a continuous process. However, the events of mitosis are easier to understand if the process is broken down into steps, or phases. There are four phases in mitosis. They are *prophase*, *metaphase*, *anaphase*, and *telophase*. In the following activity, you will learn more about these four terms.



Notice that the names of the four stages of mitosis—prophase, metaphase, anaphase, and telophase—all end with *phase*. Use a dictionary to analyze the meanings of the four different prefixes. Then, as you study the process of mitosis, check to see whether the meaning of each word is a good description of what is happening inside the cell at that stage. ✎

Preparing for Mitosis Before mitosis can begin, several events have to occur in the nucleus. First, the hereditary material in the cell must be duplicated. *Hereditary* means “passed on from parents to offspring.” The hereditary material, called **DNA**, is found within the nucleus. DNA makes up threadlike structures called **chromosomes** (KROH muh sohms). Since the DNA duplicates, the chromosomes also duplicate. The duplicated chromosomes are joined together at a point called the *centromere*. Identical hereditary instructions are carried on the two chromosomes.

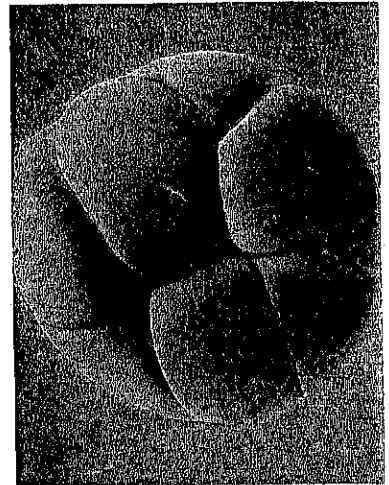


Figure 5-6. Through mitosis, an embryo steadily increases the number of its cells.

The time before mitosis, when the DNA and chromosomes duplicate, is called *interphase*. *Inter* means "between." Interphase is not a part of mitosis; it is the time between the end of one mitosis and the beginning of the next. Most of a cell's life is spent in interphase. However, interphase is a time of much activity. During interphase, the cell performs all life activities except mitosis. During this time, a cell stores the extra energy that mitosis will require.

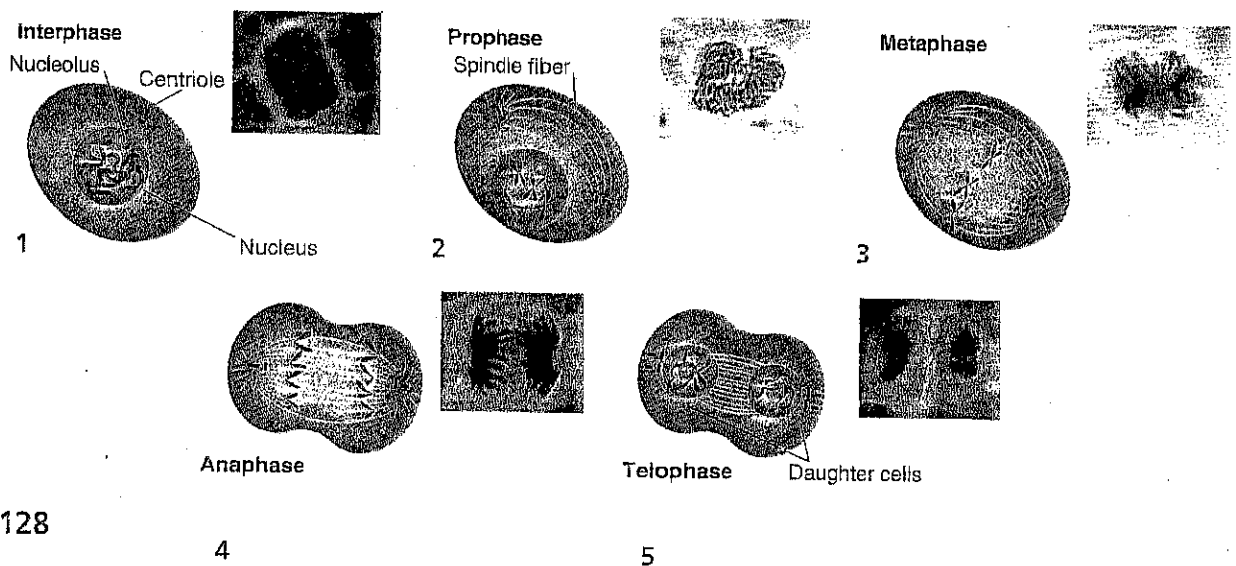
Prophase The first phase of mitosis is called *prophase*. Prophase begins as the membrane around the nucleus breaks apart. The chromosomes inside the nucleus begin to twist and thicken. As the nuclear envelope breaks apart, the chromosomes begin to move toward the center of the cell. As mitosis continues, thin tubes begin to form between organelles called *centrioles*. These tubes are called *spindle fibers*.

Metaphase During metaphase, the spindle fibers seem to push and pull the duplicate chromosomes until they are arranged in a line across the middle of the cell. The centromere of each pair of chromosomes is attached to a spindle fiber.

Anaphase During anaphase, the spindle fibers shorten and pull each chromosome pair apart at the centromere. The spindle fibers continue to shorten, pulling the chromosomes through the cytoplasm.

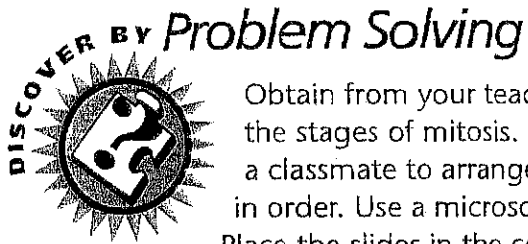
Telophase During telophase, the last phase of mitosis, the cells complete their division. As the separate chromosomes reach the opposite ends of the cell, telophase begins. The nuclear envelope forms again as the chromosomes untwist and become longer and thinner. At the end of telophase, the new cells separate. In animal cells, the cell membrane pinches together, dividing the cytoplasm in two. The number of

Figure 5-7. Mitosis takes place in four stages—prophase, metaphase, anaphase, and telophase. Each stage blends into the next stage. Interphase is not part of mitosis. However, all life activities of the cell, except mitosis, take place during interphase.



chromosomes in each daughter cell is the same as it was in the parent cell. The daughter cells now enter interphase.

The stages of cell mitosis can be seen under a microscope. In the next activity, you will have an opportunity to see for yourself what happens during mitosis.



Obtain from your teacher a set of slides showing the stages of mitosis. Before looking at them, ask a classmate to arrange the slides so they are not in order. Use a microscope to examine each slide.

Place the slides in the correct sequence. What problem-solving strategies did you use to order the slides? On a separate sheet of paper, sketch and name each stage of mitosis. ✍

The division of cytoplasm in plant cells is different from the division in animal cells. The thick cell wall of a plant cell is too stiff to pinch together. Instead, a structure called the *cell plate* forms between the daughter cells. The cell plate begins forming in the middle of the cell and moves outward until the daughter cells are separated from each other.



Figure 5-8. In both plant and animal cells, the cell membrane pinches off in the middle to form two new cells. However, in plant cells, a cell plate forms to divide the two new cells.

ASK YOURSELF

Describe what happens in a cell during mitosis.

SECTION 2 REVIEW AND APPLICATION

Reading Critically

1. Why is interphase not a part of mitosis?
2. How is mitosis different in plant cells and animal cells?

Thinking Critically

3. How would a chemical that prevented spindle fibers from forming affect the cell division of an organism?
4. What would happen if DNA did not duplicate?

Table 6-1 A Comparison of Mitosis and Meiosis

Mitosis	Meiosis
One cell division	Two cell divisions
Two daughter cells	Four daughter cells
Daughter cells have the same number of chromosomes as the parent cells	Daughter cells have half the number of chromosomes as the parent (one member of each pair)